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(71) Applicants and

(72) Inventors: LARSEN, Per, Kristian [NO/NO]; Furubakken 20, N-1395 Hvalstad (NO). HOLMEN, Nils, Otto [NO/NO]; Landøyveien 117, N-1394 Nesbru (NO).

(74) Agent: LANGAN, Hans; Bryns Patentkontor A/S, P.O. Box 765, Sentrum, N-0106 Oslo (NO).

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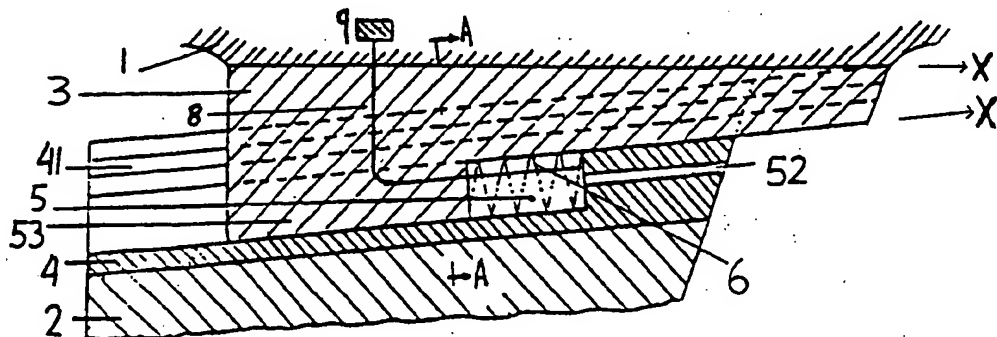
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(54) Title: SLIDABLE AND IMPACT ABSORBING KEEL



(57) Abstract: A slidable, impact absorbing keel device for a sailing vessel is provided. A vessel hull (1) and a fin keel (2) are attached to a slidably hull connection member (3) and a slidably keel connection member (4), respectively. A tongue-and-groove connection (31, 41) slidably connects the hull and the keel. A compartment (5) contains a spring (6) and is in fluid communication with the surrounding water by means of a conduit (52). The keel (2) is displaceable backwards when the vessel is running aground or comes into contact with an object below the waterline. The keel will be displaced forward to its initial position by means of the compressed spring. The keel (2) is selectively adjustable by means of the wire (8) and tensioning device (9), for purposes of regular maintenance and for trimming the vessel by shifting the center of gravity.

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## SLIDABLE AND IMPACT ABSORBING KEEL

The present invention is related to impact absorbing devices for marine vessels and more particularly to a slidable, impact absorbing keel device for a sailing vessel.

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Sailing vessels equipped with a fin keel may frequently run aground, which results in damages to the vessel's keel, hull and internal and external fittings. Such damages are often severe, may present a safety hazard while at sea and subsequently time consuming and costly to repair. The rather abrupt decelerations resulting from the fin keel striking an object or the ground below the water line may also lead to injuries to crew and passengers.

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In order to substantially reduce, and even eliminate, such vessel damages and human injuries, the Inventors have invented the present impact absorbing keel device, which will be described herein.

15

The invention is an adjustable and impact absorbing keel device for a sailing vessel. This device consists of the keel being slidably attached to the lower hull of the sailing vessel and movable in the hull longitudinal direction and relative to the hull waterline. In addition to its impact absorption features, the slidable keel may also serve as a trimming device, as the keel's longitudinal position, and thus the vessel centre of gravity, may be adjusted by means of a wire and a tensioning device.

20

The keel device will now be described with reference to the attached drawings, where the various components have been given unique reference numerals and where:

25

- Figure 1 is a partial sectional drawing along the line B-B of figure 3, showing the keel device in its initial and nominal position;
- Figure 2 is a partial sectional drawing along the line B-B of figure 3, showing the keel device in a displaced position, following e.g. the sailing vessel running aground or striking an object below the waterline; and
- Figure 3 is a sectional drawing along the line A-A of figures 1 and 2.

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Figures 1, 2 and 3 show the lower part of a vessel hull (1) attached to a slidable hull connection member (3) and the keel (2) attached to a slidable keel connection member

(4). Integrally formed in the slidable connection members (3, 4) is a tongue-and-groove connection (31, 41) which slidably connects the hull and the keel.

There is a, preferably cylindrical, compartment (5) formed within the upper region of the slidable keel connection member (4). A piston head (53), formed in the lower region of the slidable hull connection member (3), defines a rear boundary of the compartment. The compartment is in fluid communication with the surrounding water through a conduit (52), which extends from the forward compartment wall (51) to the keel leading edge. A compression spring (6), preferably a coil spring, is disposed within the compartment (5). Attached to the forward compartment wall (51) is a wire (8) which runs through the length of the compartment, through the slidable hull connection member and into the hull where it is attached (preferably in the vessel cockpit, not shown) to a tensioning device (9).

The keel (2) leading edge is, preferably towards the lower parts, equipped with an impact absorbing pad (7), which absorbs the initial impact and protects the keel structure.

When the sailing vessel is freely afloat, the compartment (5) will be kept filled with water through the conduit (52). The spring (6) will essentially not be compressed. The spring may be selected such that the spring properties are suitable for the weight of the applicable sailing vessel. The conduit may also be sized to suit the vessel in question.

When the keel (2) strikes an object or the ground below the waterline, the resulting impact will force the keel to be displaced towards the rear of the hull (1), along an axis (x') and slightly downwards with respect to the hull nominal waterline (fig. 2). Some of the initial impact may have been absorbed by the pad (7) at the keel leading edge. The keel will slide by means of the tongue-and-groove connection (31, 41) in the slidable hull connection member (3) and the slidable keel connection member (4), respectively.

Such rearward keel motion will diminish the volume of the compartment (5), whereby:

- a) The water in the compartment will be forced by the piston head (53) to flow through the conduit (52) and out into the water surrounding the keel, and
- b) the spring (6) will become increasingly compressed, depending on the magnitude of impact.

Both hydraulic and mechanical impact absorption is thus achieved. The spring properties, as well as the compartment and conduit volumes, may be chosen to best suit the applicable sailing vessel.

- 5 Some of the kinetic energy generated by the rearward motion of the keel will be stored in the spring (6). The resulting compressive spring force will tend to push towards the forward compartment wall (51) and the piston head (53), thereby moving the keel to its initial position (fig. 1). If the vessel has run aground, such spring induced keel movement may contribute to bringing the vessel afloat.

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- The keel is selectively adjustable by means of the wire (8) and tensioning device (9). The slidable keel should as a part of the regular maintenance of the vessel, be moved along the axis ( $x'$ ), in order to verify that it is functioning properly. The feature of being able to selectively adjust the keel's position along the axis ( $x'$ ), may also be utilised to
- 15 trim the vessel, i.e. by shifting the centre of gravity. Upon selectively tightening the tensioning device and thus the wire, the keel is shifted rearward to the selected position and the spring (6) is compressed correspondingly. When the tension in the wire selectively is released by unlocking the tensioning device, the compressive spring force will push towards the forward compartment wall (51) and the piston head (53), thereby
- 20 moving the keel to its initial position (fig. 1).

Patent Claims

1.

An impact absorbing keel device for a sailing vessel,

5 c h a r a c t e r i s e d i n t h a t the keel (2) is slidably attached to the lower hull (1) of the sailing vessel and movable in the hull longitudinal direction and relative to the hull nominal waterline.

2.

10 The device of Claim 1, c h a r a c t e r i s e d i n t h a t the keel (2) is attached to the hull (1) by means of a tongue-and-groove connection (31, 41) integrally formed in a slidable hull connection member (3) and a slidable keel connection member (4), respectively, with the slidable connection members (3, 4) being attached to the hull and keel, respectively.

15

3.

The device of Claim 2, c h a r a c t e r i s e d i n t h a t a compartment (5) is formed within the upper region of the slidable keel connection member (4) and that a piston head (53) which defines a rear boundary of said  
20 compartment is formed in the lower region of the slidable hull connection member (3), and that the compartment is in fluid communication with the surrounding water by means of a conduit (52) which extends from the forward compartment wall (51) to the keel leading edge.

25 4.

The device of Claim 3, c h a r a c t e r i s e d i n t h a t said compartment (5) holds a compression spring (6), preferably a coil spring, and that said compartment preferably has a cylindrical shape.

30 5.

The device of Claim 1, c h a r a c t e r i s e d i n t h a t the keel (2) leading edge is equipped with an impact absorbing pad (7), preferably at a lower region thereof.

35 6.

The device of Claim 2, c h a r a c t e r i s e d i n t h a t said slidable connection members (3, 4) are mutually slidable in the hull longitudinal

direction and along an axis ( $x'$ ) which lies in a hull nominal vertical plane and is inclined forwardly and upwardly at an angle with respect to the hull nominal water line.

7.

5 The device of Claim 1, characterised in that the keel (2) is displaceable backwards with respect to the hull (1) when a rearward acting force is applied to keel, and that the keel is displaceable forwards when a forward acting force is applied to the keel.

10 8.

The device of Claim 7, characterised in that said forward force is generated by said compression spring (6), which has been compressed by said rearward force being generated by the impact as the vessel keel is coming into contact with an object or the ground below the waterline.

15

9.

The device of Claim 1, characterised in that said keel (2) and slidable keel connection member (4) are displaceable backwards and downwards with respect to the hull (1) and the slidable hull connection member (3) when subjected to a rearward acting force, and in that said keel and slidable keel connection member are displaceable forwards and upwards with respect to the hull and the slidable hull connection member when subjected to a forward acting force.

20

10.

25 The device of Claim 1, characterised in that said keel (2) is selectively adjustable along the axis ( $x'$ ) by means of the wire (8), the tensioning device (9) and the compression spring (6).

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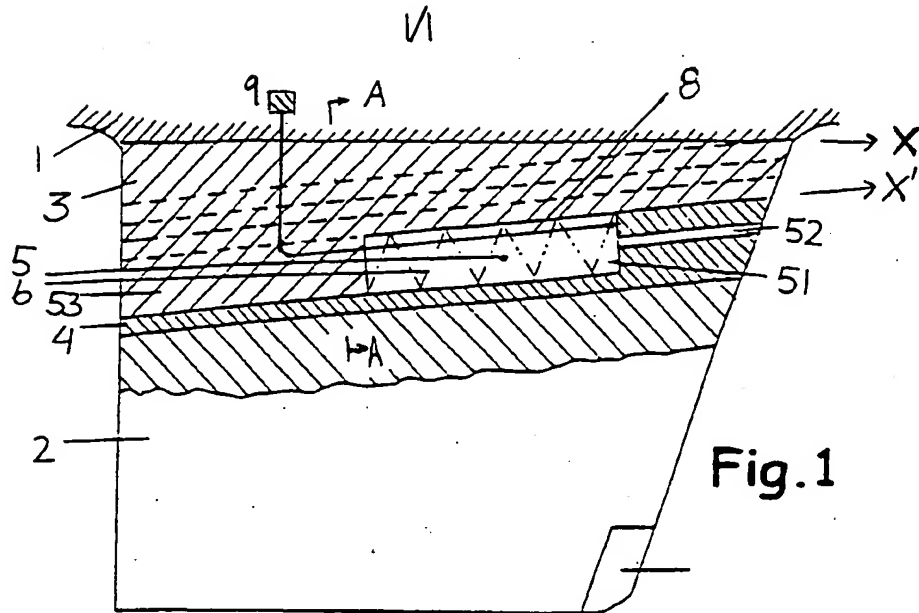


Fig. 1

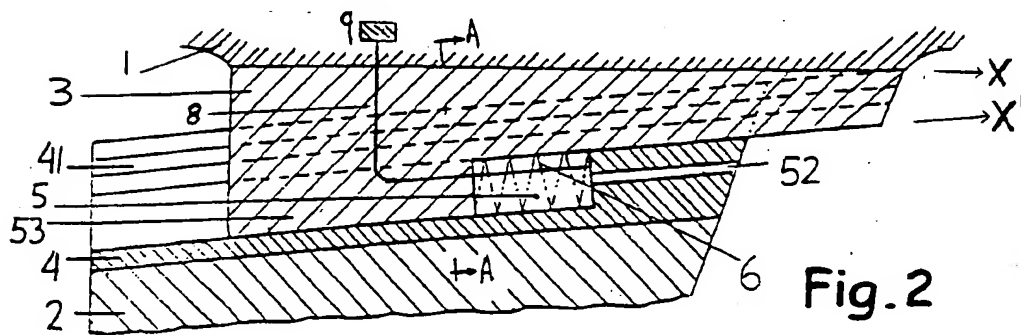


Fig. 2

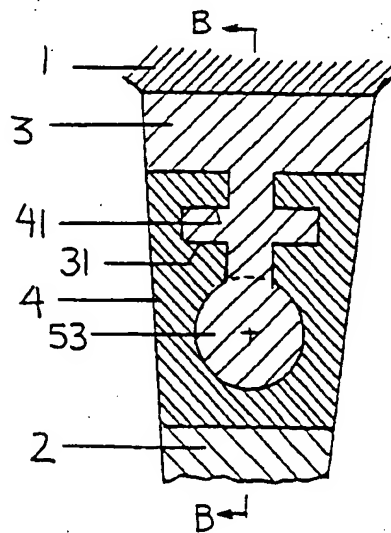


Fig. 3

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 00/00172

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B63B 3/38, B63B 43/18

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages              | Relevant to claim No. |
|-----------|---|-----------------------|
| X         | US 1730844 A (W.S.DUPUIS), 8 October 1929<br>(08.10.29), page 1, line 29 - line 62, figures 1,2 | 1,2,5,6,7             |
| A         | --  | 3,4,8-10              |
| A         | SE 444296 B (MAJ-BRITT BOHLIN); 7 April 1986<br>(07.04.86)                                      | 5                     |
| A         | --  |                       |
| A         | DE 19604966 A1 (MISBACH, MARCO), 7 August 1997<br>(07.08.97)                                    | 1-10                  |
| A         | --  |                       |
| A         | DE 3722259 A1 (KOEPL, J. BRUNO), 19 January 1989<br>(19.01.89)                                  | 1-10                  |
|           | --  |                       |

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Name and mailing address of the ISA

Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM  
Facsimile No. +46 8 666 02 86

Authorized officer

Christer Jönsson/js  
Telephone No. +46 8 782 25 00



**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

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International application No.  
PCT/NO 00/00172

| Patent document<br>cited in search report |          |    | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|----------|----|---------------------|----------------------------|---------------------|
| US  | 1730844  | A  | 08/10/29            | NONE                       |                     |
| SE  | 444296   | B  | 07/04/86            | SE 8101365 A               | 04/09/82            |
| DE  | 19604966 | A1 | 07/08/97            | NONE                       |                     |
| DE  | 3722259  | A1 | 19/01/89            | NONE                       |                     |